UNIVERSITY OF HAWAII

Environmental Center
Office of the Director

RG:0007

MEMORANDUM

May 11, 1972

TO: Environmental Council

VIA: Richard E. Marland, Chairman

FROM: Doak C. Cox

PROPOSED DRAINAGE CANAL
IN ALA MOANA PARK, OAHU

Summary

Plans developed by the City for transportation of drainage water through Ala Moana Park have clear advantages in alleviating a drainage problem inland and in diverting the polluted water from Kewalo Basin, where it may have a significant deleterious effect. The plan to discharge the drainage water into the Ala Wai entrance channel appears to minimize detrimental environmental effects, and appear distinctly preferable to the alternative of discharging the water to or through the Ala Moana beach.

The major detriments with the plans prepared by the City appear to be the loss of trees in the Park and the replacement of land area in the Park by water area in an open canal between Piikoi Street and an existing lagoon in the eastern part of the Park. The recreational value of the water area is questionable because of the poor sanitary quality of the drainage water.

One alternative that appears to merit further examination is use of a covered box drain in the section between Piikoi Street and the lagoon. Objections to this alternative have been raised in connection with increased costs of construction and of sediment removal. The increased costs would be to some extent and perhaps completely offset by the increased land area and decreased loss of trees in the Park. The importance of the sedimentation problem is questioned in the light of the nature of the area that is drained by the system and various alternative means have been discussed in the report for coping with what sediment is to be expected.

Introduction

This report was prepared for the Environmental Council in response to a request of its Chairman for a review of plans by the City and County of Honolulu for a new drainage structure through Ala Moana Park and the environmental issues that have been raised in connection with the project.

In its preparation I have consulted with the following members of the University community: Ruth A. Gay, Department of Botany; H. Ronald Hurov, Community Pesticides Study; and Jack K. Yuen, Department of Civil Engineering. Gay and Hurov are also members of the Hawaiian Botanical Society, an organization that has been active in identifying particular environmental detriments with some of the means that have been proposed to cope with the drainage problems.

A preliminary draft of this report was submitted to the City Departments of Public Works and of Parks and Recreation. Written comments were received from Edward Y. Hirata of the Department of Public Works and oral comments from Paul Weissick of the Department of Parks and Recreation.

Time limits have unfortunately not permitted the review of the present draft by any of the consultants and reviewers; hence, there may well be errors in detail for which I must take sole responsibility.

Present drainage system and its inadequacy

An area of Honolulu of about 350 acres lying inland of Ala Moana Park (fig. 1) is now drained through a number of drainage structures to a drainage canal running the length of the Park more or less parallel to and not far makai of the mauka boundary of the Park and Ala Moana Boulevard (figs. 2 and 4A). Near the west end of the Park the canal enlarges to form a lagoon which is then drained to Kewalo Basin by an extension of the canal and box drains beneath Ala Moana Park road and the road and wharf circumferential to Kewalo Basin, near McWayne Marine Supply. Near the east end of the Park the canal is enlarged to form two lagoons in series from which the water flows to the Ala Wai Drainage Canal through an extension of the canal and a box drain under Ala Moana Park road and wharf at Waikiki Yacht Club. The major part of the flow in the drainage canal now occurs westward to Kewalo Basin, and much of the eastern part of the canal is filled with silt and vegetation.

The lowland part of this area is poorly drained by the present system and subject to flooding during storms. To alleviate the flooding the City has under construction at the present time a double 14 x 8 ft. box drain along Pensacola Street and its extension to the line of the present drainage canal. To carry the water from the Pensacola drain, from the existing 8 x 5 ft. box drain under Piikoi Street, as well as from a large number of minor drains now entering the drainage canal in the Park, the City has planned a major change in the drainage structures within the Park (figs. 3 and 4B).

Proposed new drainage system

From the new Pensacola drain westward to the lagoon near Kewalo Basin, the present drainage canal is proposed in the City's plans to be replaced by a reinforced concrete pipe ranging from 36 in. at the east end to 54 in. drain at the west. The canal will then be filled. The major flow will be carried eastward from the new Pensacola drain through double 14 x 8 ft. box drains following the present drainage canal as far as Piikoi Street drain. In the original plan, the flow beyond to the first of the present lagoons at the Ala Wai end of the Park would have been carried by an open canal 59 ft. wide. From the lagoon, a new channel is planned to be opened to the Ala Wai Yacht Harbor entrance channel next to the Magic Island revetment, passing under a new bridge constructed to carry Ala Moana Park road. The second lagoon and the portions of the present canal between the first and second lagoon and between the second lagoon and the Ala Wai Yacht Harbor was, in the original plan, to be filled.

In the original plan the new, wide canal between the Piikoi Street and the lagoon would have followed the present drainage canal, with somewhat more of the widening being accomplished on the makai side, except near the lagoon, where the new canal would have followed a gentle curve where the present canal makes a sharp bend. In plans subsequently developed, the canal would follow the present drainage canal for only a part of its length, an attempt being made to avoid trees by meandering. The alignment in the latest plans is shown in figure 3, but a recent decision has been made not to fill the second lagoon, the connecting channel, and the present exit to Ala Wai Yacht Harbor, as shown in the figure, but to leave these portions of the existing drainage system, as well as the first lagoon, unfilled.

The area traversed by the new large canal from Piikoi Street to the first lagoon has an elevation of approximately 4 feet above mean sea level. The canal would have vertical masonry walls down to shelves on both sides 1.25 ft. below mean sea level. Below the level of these shelves the canal would be trapezoidal in shape and unlined.

In the original plans, the total width was to be 59 ft., the width of the shelves 4 ft., the sides in the trapezoidal section a slope of 2 horizontal to 1 vertical, and the bottom a width of 12 ft. and a depth of 11 ft. below mean sea level with no longitudinal slope. The latest plans indicate a total width varying from 32 ft. to 56 ft., and it is not clear whether the narrowing is to be accounted for by narrowing of the shelves, increase in the slope of the sides in the trapezoidal section, narrowing of the bottom, or decrease in the depth of the bottom with the introduction of horizontal slopes (see fig. 5).

The rationale for the complex cross section is that the canal will serve as a recreation feature, for model boat sailing, etc. The shelf is provided so that anyone falling into the water can readily climb out.

At its entrance into the lagoon, the new canal must cross the sewer main that serves Waikiki, a 6 x 4 ft. concrete box sewer with its top at about -1 ft. The plans call for the canal to cross this sewer main at the same point and by the same manner as the present drainage canal--by passing over it. The canal invert level must thus be raised from -11 ft. to -1 ft. (fig. 4B). Seaward of the sewer main, the invert level of the lagoon and channel would be dropped gradually from -3 ft. to -11 ft. at the Park road.

As originally planned, the construction of the new, wide drainage canal from the Piikoi drain to the first lagoon would have entailed the potential destruction or transplanting of about 350 trees in Ala Moana Park, of which no more than two-thirds could be saved by transplanting. Many of these trees are considered to have considerable value because of their rarity, and some perhaps because of the circumstances of their planting.

The Department of Parks and Recreation has, understandably, been opposed to the plan. On the basis of concerns for the destruction of trees and doubts as to the survival of many of the trees transplanted, the Hawaiian Botanical Society, joined by other conservation groups, requested the City to examine or reexamine a number of alternative means.

Alternatives originally discussed

All or most of the alternatives are here discussed with respect to their major respective advantages or disadvantages as these were initially envisaged. Additional comments pertinent to the advantages and disadvantages of the apparently most favorable plans will be presented in later sections.

1. Do not modify the present drainage structures in the Park.

Advantages: No trees would be destroyed. All three present lagoons would be preserved.

Disadvantages: The new Pensacola drain will result in more efficient drainage of a considerable area mauka, but unless the water is effectively carried to sea it will result in flooding of makai lands. The present drainage canal through the Park is considered to have inadequate capacity to carry the additional load. Hence flooding will occur inland of the Park.

2. Enlarge the present drainage canal extending westward from the Pensacola drain to Kewalo Basin.

Advantages: Elimination of the tree destruction east of Piikoi Street attendant on the present plan.

Disadvantages: Possible tree destruction west of the Pensacola drain. Continuation of drainage discharge to Kewalo Basin which is considered objectionable because of effects on fish in Kewalo Basin. Reconstruction of makai end of Pensacola drain now headed eastward.

3. Construction of a new canal direct to the sea from somewhere in vicinity of the Pensacola or Piikoi drains.

Advantages: Elimination of tree destruction in east part of Park.

Disadvantages: Possible tree destruction in center of Park. Disruption of Park facilities. Pollution of swimming lagoon on Park waterfront waters unless canal were carried across lagoon and reef to open ocean and separated by walls from remnants of lagoon. Major destruction of reef in the latter case.

4. Decrease width of large open canal by increasing its depth and slope.

Advantages: Reduction in destruction of trees.

Disadvantages: Hydraulic capacity is limited not by bottom slope and depth of canal but by limit on hydraulic grade set by a +2 ft. msl. design flood water level at the connection between the Pensacola Street drain with the drainage system in the Park, with only 0.5 to 0.75 ft. head loss from Piikoi Street to sea at high tide, complicated by high sill (-1 ft.) at a sewer main crossed just before entrance to lagoon. Hence carrying capacity cannot be increased effectively by deepening.

5. Realignment of large open canal from Piikoi Street to first east lagoon with meanders to avoid trees (as will be discussed later, several variants of this alternative have been proposed, of which the one apparently preferred by the Department of Public Works is shown in fig.3).

Advantages: Some reduction in destruction of trees, especially most valuable ones.

Disadvantages: Some additional cost.

6. Substitution of a double or triple box drain under or partly under Ala Moana Blvd. for the planned large open canal.

Advantages: Elimination of tree destruction.

Disadvantages: Serious interference with traffic on major arterial during construction period. Considerable increase in construction and maintenance cost. Replacement of major communications cable between Ala Moana Blvd. and present drainage canal.

7. Reduction of width of large open canal by conversion to rectangular cross section without marginal shelves. Construction: a) along the present drainage canal, b) at Park boundary along Ala Moana Blvd., or c) along the meandering route in alternative 5.

Advantages: Considerable reduction in tree destruction.

Disadvantages: Elimination of recreational opportunities afforded by present design. Safety requirements would necessitate fencing both sides of canal. Esthetic objections. Increased cost.

8. Substitution of a double or triple box drain for the large open canal. Construction: a) along present drainage canal or b) along meandering route in alternative 5.

Advantages: Considerable reduction in destruction of trees. Addition to Park ground area.

Disadvantages: Loss of recreational opportunities afforded by present design. Considerable additional cost. Difficulty in sediment removal.

Alternatives studied and effects on trees

Four alternative plans or variants of plans were discussed by representatives of the Hawaiian Botanical Society and other conservation organizations at a 2 March 1972 meeting with representatives of the City Department of Parks and Recreation and Department of Public Works:

Original plan (September 1971). Open canal of 59 ft. width with modified trapezoidal cross section. (Plan A of Hawaiian Botanical Society)

Alternative 7b. Open canal of 40 ft.(±) width with rectangular cross section at edge of Park. (Plan B)

Alternative 5a. Open canal of 59 ft. width with modified trapezoidal cross section, meandering to minimize tree loss. (Plan C)

Alternative 8a. Covered canal (or box drain) of 40 ft.(±) width following present canal. (Plan D)

Two variants of alternative 5a have apparently been examined since:

5b. As modified by Department of Parks and Recreation (Plan E)

5c. As further modified by Department of Public Works (Plan F) (figs. 3 and 4B).

5d. As still further modified to retain the connection between the first and second lagoon and the outlet to the Ala Wai Yacht Harbor from the second lagoon as well as the new outlet to the Ala Wai entrance channel.

The trees in the areas affected by these plans have been identified by the Hawaiian Botanical Society and classified in accordance with the following code:

Red: To be retained and protected at all cost

Orange: To be retained

Blue: To be transplanted with extreme care

Green: To be transplanted only if necessary

Brown: To be transplanted or destroyed

The total number of trees that would potentially be affected by Plan A was found to be somewhat larger than the 350 originally estimated. The number of trees within the channel itself has been estimated for each of the plans as follows:

Tree code	Plan	Original	7b	5a	8a	5b*	5c&d*
Red		13	0	0	0	5	3
Orange		30	10	14	2	35	36
Blue		32	1	4	1	4	5
Green		10	10	19	7	20	25
Brown		0	3	1	2	2	2
Totals within channel		85	24	38	12	66	71

*Estimates prepared since the 2 March 1972 meeting

The numbers of trees that would have to be destroyed or transplanted by three of the plans were estimated as follows:

Location	Plan	7b	5a	5c&d
Channel area		24	38	12
Additional area within 10 ft. of channel allowed for construction		9	15	11
Unmapped specimens		0	6+	0
Totals		33	59+	23

The Botanical Society provided a number of recommendations as to the labelling, limitation of destruction, air layering of rare trees to be transplanted, means for pruning and transplanting, and contractual provisions for transplanting.

Present status

Construction drawings have been prepared not only for the original plan (by the City) but for three of the alternatives above discussed for the portion east of Piikoi Street:

5c. A variant of the meandering open canal with modified trapezoidal cross section of 59 ft. width (by the City), with the second lagoon and present exit filled (fig. 3).

5d. The same variant with the second lagoon and present exit left unfilled.

In addition there has been, I understand, some consideration by the State:

7b. An open canal with rectangular cross section of unknown width.

No plans have been prepared for alternative 8a, a covered box drain, in spite of the fact that the tree loss will be least for this alternative.

The value of the trees, and other factors that may have been overlooked or inadequately considered in the choice of the two alternatives for which drawings have been prepared, are discussed in the following sections.

Park history and title

The partly tidal lands now occupied by Ala Moana Park appear to have been among the public lands of the Kingdom of Hawaii transferred by the Republic of Hawaii to the United States by the Joint Resolution of Annexation of 1897. They were transferred back to the Territory of Hawaii by presidential proclamation on 25 October 1927 under the provisions of Section 91 of the Organic Act of 1900 as amended in 1910, which restricts the use of such land to public purposes. By proclamation of the Governor 16 January 1928, they were then transferred by the Territory to the City and County of Honolulu ". . . upon condition, nevertheless, that said property be used solely as a public park or for other public purposes of like nature, and upon ceasing to be so used as to the whole or any part thereof, said property together with any and all additions, improvements and appurtenances, shall revert to the Territory and its successors."

The nature of the title to the park lands was the subject of a 30 September 1964 memorandum from A. W. Lau, Deputy Attorney General, to J. P. Ferry, Chairman, Board of Land and Natural Resources which stated: ". . . our conclusions that under the authority of Section 91 of the Organic Act, and Act 271 Session Laws of Hawaii 1927 (item 27), the Governor of the Territory transferred the fee simple title to Ala Moana Park area of 78-87/1000 acres, to the City and County of Honolulu, subject to the condition that it be used for park purposes. Upon ceasing to be so used it shall revert to the State."

The lands, which had been used for a dump,were converted to a park in the early 1930's (Beacon, April 1970, p. 44). Through the efforts of the Outdoor Circle, many trees were donated and planted. The canal and lagoons were created during the same period. The park was formally dedicated in July 1934 by President Roosevelt.

The reversion clause in the transfer of title from the Territory to the City and County clearly provides grounds for a strong interest by the State, as successor to the Territory, in any use of the lands of the park that depart significantly from park use. It would seem that some sanction to the continuing conveyance of drainage waters through the park has been provided by long usage.

It is not clear, however, to what extent the City is free to enlarge the drainage structures without approval from the State, especially if the enlargement may to any degree interfere with park usage. Presumably the State would have little reason for concern with the construction of a pipe or a box drain such as those proposed from the Piikoi drain to the west lagoon, over which park usage may be reestablished, or with an open canal such as that proposed from the Piikoi drain to the east lagoon, if its recreational and esthetic utility to the park are equivalent to the utility of an equivalent dry-land area. The recreational and esthetic values of the proposed open canal will be discussed in subsequent sections.

The concerns of the State have been expressed by a Senate concurrent resolution adopted by the Sixth Legislature in 1972 (Appendix A) and by a letter from the Governor to the Mayor of the City and County of Honolulu dated 13 March 1972 (Appendix B).

Value of trees

Representatives of the Hawaiian Botanical Society have recently estimated the value of the trees actually within the construction area of the canal in those alignments based on a tree-value schedule used by the State of Michigan, with facts based on rarity from 0.5 to 2.0 (Appendix C).

Within the actual canal area, the number of trees (in parentheses) and their value for those alternatives previously discussed, are as follows:

Tree code	Plan Original	8a	5c&d
Red	$ 86,372 (13)	$ 0 (0)	$ 13,932 (3)
Orange	149,490 (30)	9,966 (2)	179,388 (36)
Blue	106,304 (32)	3,322 (1)	15,610 (5)
Green	24,920 (10)	17,444 (7)	62,300 (25)
Brown	0 (0)	3,322 (2)	3,322 (2)
Totals	$367,086 (85)	$34,054 (12)	$274,552 (71)

The value of the trees in the construction area that would potentially be affected, using an average rarity factor, is estimated as follows:

Location	Plan Original	8a	5c&d
Within canal	$ 367,086 (85)	$34,054 (12)	$ 274,552 (71)
Outside canal	$1,122,138 (279)	36,198 (9)	1,206,600 (300)
Total	$1,489,224 (364)	$70,252 (21)	$1,481,152 (371)

It will be seen that the tree values potentially lost by the original plan would be far greater than those lost in a covered box drain system (8a) and that the values lost in the meandering-open-canal scheme are not materially lower than those in the original plan.

These estimates do not discriminate between values of trees to be destroyed and trees that might be transplanted. The estimates do not include values assignable for sentimental reasons attached to the planting of many of the trees as memorials.

Water quality considerations

Apparently water quality considerations led to the decision to reduce the discharge of drainage water eastward to Kewalo Basin and to accommodate the additional drainage by discharging it eastward instead to the Ala Wai entrance channel. There is some rationale to this decision in that the water quality in the Ala Wai Canal and Yacht Harbor is apparently already continuously poor, the quality in Kewalo Basin is only intermittently poor, and poor water quality is a clear hazard to the bait fish in holding tanks on fishing boats in Kewalo Basin.

That the hazard to fish is not a theoretical one is indicated by a fish kill in the canal that was reported by the State Division of Fish and Game on 24 March 1971. An estimated 8,000 Mollienesia (mostly from 1 to 2-1/2 in. in length), 20 Tilapia (of which 8 were longer than 8 in.), and 120,000 shrimp were killed in a 1/4 mile section of the canal centering on the Piikoi drain. Subsequent analyses of the water by the Department of Health indicated the following:

Chlorides	15,000 mg/l
DO	4.9 "
As	0.001 "
Pb	0.05 "
Cu	0.2 "
Zn	0.06 "

The implications of poor quality in the drainage water may not have received due consideration, however, in the plan to use the new large canal through the eastern part of Ala Moana Park for recreation--a plan that has significantly affected the choice of an open-canal design.

The following analyses of samples collected from the present drainage canal by the Department of Health on 26 January 1972 are pertinent:

Water quality analyses

	Total Coliforms (MPN/100ml)	Fecal Coliforms (MPN/100ml)	Total N (mg/l)	Total P (mg/l)	TDS (mg/l)	DO (mg/l)
1. Exit from second east lagoon	240,000	240,000	0.97	0.12	16,500	4.5
2. Exit from west lagoon	46,000	9,300	0.85	0.14	19,300	4.4
3. Entrance to west lagoon	240,000	4,300	0.99	0.16	8,400	8.9
4. At Piikoi drain	240,000	46,000	1.78	0.34	1,500	4.4
5. Entrance to first east lagoon	4,300	2,300	1.38	0.11	11,200	7.7

The Hawaii water quality standards pertinent to bacterial concentrations in coastal waters, including tidal waters such as those of the present and proposed canals are as follows:

	Total coliforms		Fecal coliforms	
	Mean	Upper decile	Mean*	Upper decile*
Class A (Recreation, etc.)	1000	2400	200	400
Class B (Immediate vicinity of docks in harbors)			400	1000

*For 30-day period

Although the Department of Health analyses quoted above which pertain to samples that were collected on a single day, cannot conclusively prove a violation of statistical standards, it seems quite probable that the water quality in the present canal grossly violates the standards for recreational waters.

With the proposed diversion of the major drainage eastward rather than westward, there will probably be a tendency for the bacterial concentrations in the eastern part of the drainage system to increase. Offsetting this tendency, however, will be the improved flushing in the deeper canal and the increased rate of bacterial die-off in the more saline water. The lower concentrations at the lagoons than in the central parts of the present canal probably result from such effects. Actual hazards to human health is poorly indicated for water-contact sports by the concentration in the water of fecal coliforms (Henderson, Jour. Sanitary Engineering Div., Amer. Soc. Civil Engrs., Dec. 1968), and the significance of total coliform concentrations is quite doubtful. Still, it seems questionable that recreational use should be encouraged in the Ala Moana drainage waters if the analyses quoted will be representative of these waters when proposed changes have been made in the drainage system.

Whether access to the waters should be especially discouraged on the grounds of a health hazard depends upon the probable source of the fecal coliforms. If they are likely to be derived from human sewage by leaking sewers or cesspool seepage, fencing or covering of the canal should be planned regardless of economic, esthetic or other considerations. Unfortunately, there seem to be little knowledge pertinent to the origin of the fecal coliforms.

Obstruction from sewer main

The size of the drainage structure required through Ala Moana Park is dictated by the design maximum flood flow, the length of the structure, the design peak flood water level at the entrances of the major drainage structures into Ala Moana Park, design maximum high tide level, and the obstruction provided by the sewer main which is crossed by the canal just before it reaches

the lagoon. Assuming that all of these constraints except the last are dictated by natural conditions or essentially unchangeable present drainage structures, it may be asked whether the sill at the sewer provides a significant constraint and if so whether its modification has been considered.

The configuration of the sill crossing is essentially that of a broad-crested weir, 10 ft. shallower than the canal upstream. It is noted that the canal will be considerably widened at the sewer crossing so that at high tide, when the critical conditions pertain with respect to discharge, the flow cross section over the sewer is somewhat larger than that in rest of the canal. The hydraulic radius of the section over the sewer will, however, be considerably greater than the normal section, and the transition in cross section will be abrupt. Hence it seems possible that, if the constraint of the sewer were reduced, a somewhat smaller section could be used for the channel.

The present sewer could, presumably, be replaced by an invented syphon at the canal crossing. Possibly some assistance would be provided by pressure from the force-main section of the sewer extending from Waikiki to the Ala Moana side of the Ala Wai Canal. Possibly also, the canal crossing could be relocated eastward where the sewer is deeper, although this seems unlikely.

Alternatively, an additional opening could be provided beneath the sewer and the channel between the sewer and the lagoon deepened so that flow from the canal to the lagoon would occur both above and below the sewer.

The objective in each case would be to reduce the head loss at the sewer crossing so that a higher hydraulic gradient, a smaller cross section, and a higher velocity could be obtained in the channel or drain upstream.

Sedimentation and sediment removal

A major objection to the replacement of the proposed open canal by a box drain has been the difficulty and expense that have been considered entailed in removing sediment from the box drain. It is recognized that, because of the low hydraulic gradient between the entrances of the drainage system into the park and the ocean (or the sewer crossing) a large flow cross section must be provided for the drainage structure in the park, that the flow velocity in the section will be small, and that sediment transported through the higher velocity sections of the drainage system inland will tend to be deposited in the section within the park, especially in the section upstream of the sewer crossing.

It should also be recognized, however, that the drainage system serves only areas of the city already developed, and hence not especially liable to accelerated erosion, and no mountain areas producing large amounts of sediment. Experience with sedimentation in the Ala Wai Canal and its tributaries that receive the flow of Makiki, Manoa, and Palolo Streams which drain mountain areas is not pertinent to the estimation of sediment yield from the drainage system tributary to Ala Moana. Neither is experience with drains in developing areas of the city in which grading is in progress for street or lot development.

Examination of the maintenance record of the existing drainage canal seems well warranted to determine the actual volume of silt carried to the park from the drainage area.

It may be noted that the City plans call for the portion of the drainage system from Pensacola Street to Piikoi Street, about 500 feet, to be double 14 x 8 ft. box drains, with inverts 7 feet below sea level without slope. If sedimentation and sediment removal are not considered problems in this section, it is not clear why sedimentation and sediment removal would necessarily constitute problems if the same kind of structure were continued the additional distance to the lagoon, approximately 1300 feet, especially if the hydraulic gradient were increased by reducing the obstruction of the sewer and the velocity were increased by that means and by the use of a smaller cross-section than that of the planned canal, approximating the characteristics of the Pensacola box drain.

If the obstruction of the sewer cannot be reduced, the question may then be asked whether the smaller higher velocity section (a multiple box drain) could not be continued some distance through the park, so that only the downstream portion would have to be enlarged as an open sediment basin. Possibly the only enlargement required would be in the section immediately upstream from the sewer crossing--a new lagoon between the sewer and Ala Moana Boulevard.

Alternatively, a silt basin could be created in the vicinity of the junction of the Piikoi drain with the drainage structure through the park, so that the rest of the structure to the sewer crossing could be a covered multiple-box drain.

If provision must be made for sedimentation and sediment removal upstream from the lagoon, the question may then be asked whether a sediment trap could not be created in the vicinity of the Piikoi drain exit so that the major length of the canal could be shallower, narrower, carrying water at higher velocity to prevent sedimentation, and hence covered.

Finally, if the sediment load is sufficiently high to make maintenance of the drainage structure a problem, and if a major length of the structure within the park really is needed to function as a sediment trap, an alternative appearing worthy of investigation would be the use of a large-cross-section multiple-box drain from which sediment would be removed, as necessary, by a pre-installed slusher system or by dewatering and ordinary means of excavation and removal perhaps, in one box at a time. Critical to the feasibility of this alternative is the frequency of cleanout required, a function of the dimensions of the drain and of the rate of sedimentation, a question already mentioned.

Safety and esthetics

Valid objections to a canal of rectangular cross section through the park on the grounds of the hazard presented by the vertical walls. The canal would have to be fenced, and fencing would be esthetically objectionable. The canal itself may be considered esthetically unattractive.

The proposed canal, however, is objectionable on much the same grounds. Although the proposed shelves at water level reduce the danger of drowning, 5-foot falls to the shelves are still possible, and the vertical walls above water level in the proposed cross section will have the same appearance as the vertical walls in a rectangular section.

Cost and land values

Objections have been raised to the box drain on the basis of the greater costs of its construction and maintenance as compared with the open canal. The objection would be valid if the area of open canal had the same value for recreational purposes as equivalent land area in the park and if there were no differentials in the value of trees lost to construction between the open-canal and box-drain schemes.

It should be considered that either land area or water area fully utilizable for recreation has the same unit value as commercial land area in the vicinity. The water quality consideration already discussed has a bearing on the recreational value of the canal. If there is not full recreational value in the water area, the value of the land that would be available over the box drain might cover a considerable part of the cost or even more than cover the cost of the cover.

The differentials in the values of trees lost in the two schemes have also already been discussed.

Conclusions

The plans developed by the City for transportation of drainage water through Ala Moana Park have clear advantages in alleviating a drainage problem in low areas of the city tributary to the Pensacola and Piikoi drains, and in diverting the polluted water from Kewalo Basin, where it may have a significant deleterious effect on fish in holding tanks on fishing vessels. The plan to discharge the drainage water into the Ala Wai entrance channel appears to minimize detrimental environmental effects, and appear distinctly preferable to the alternative of discharging the water to the Ala Moana swimming area or across this area through a new channel across the reef to the ocean.

The major detriments with the plans prepared by the City appear to be the loss of trees in the Park and the replacement of land area in the Park by water area in an open canal between Piikoi Street and an existing lagoon in the eastern part of the Park. The recreational value of the water area is questionable because of the poor sanitary quality of the drainage water.

One alternative that appears to merit further examination is use of a covered box drain in the section between Piikoi Street and the lagoon. Objections to this alternative have been raised in connection with increased costs of construction and of sediment removal. The increased costs would be to some extent and perhaps completely offset by the increased land area and decreased

loss of trees in the Park. The importance of the sedimentation problem is questioned in the light of the nature of the area that is drained by the system, and various alternative means have been discussed in the report for coping with what sediment is to be expected.

Critical to the appraisal of the practicality of this alternative and its variants are hydraulic and economic question whose consideration has not been possible in the time available for preparation of this report. The benefits of the alternative appear sufficiently great, however, to warrant its thorough consideration.

A point not discussed earlier in the report is that within the next year a master plan is to be produced for Ala Moana Park. If construction of the proposed drainage structures across the Park by any alternative is begun before the plan is sufficiently developed, the planning will have to conform to the new construction. It would clearly be advantageous if the reverse were possible.

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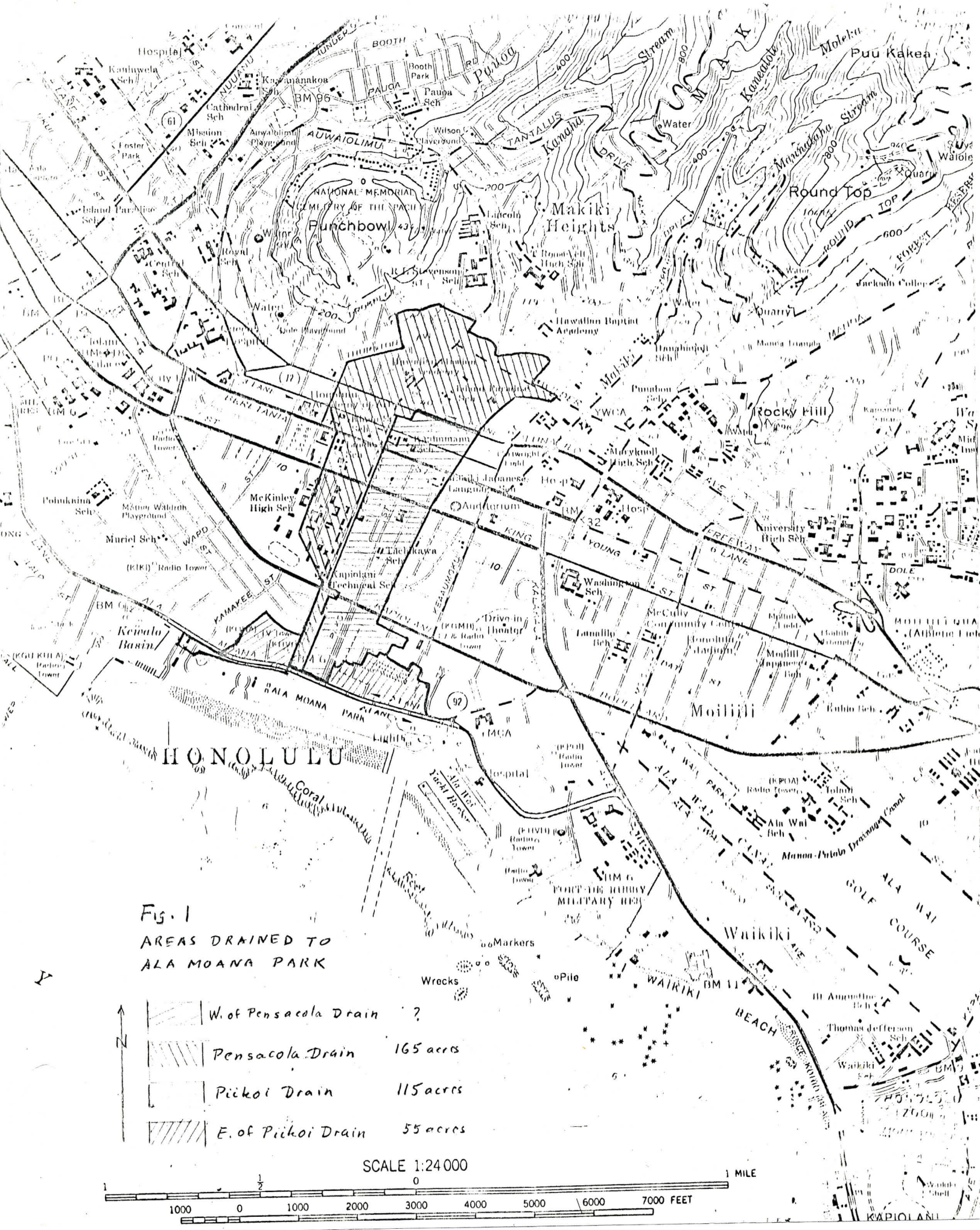
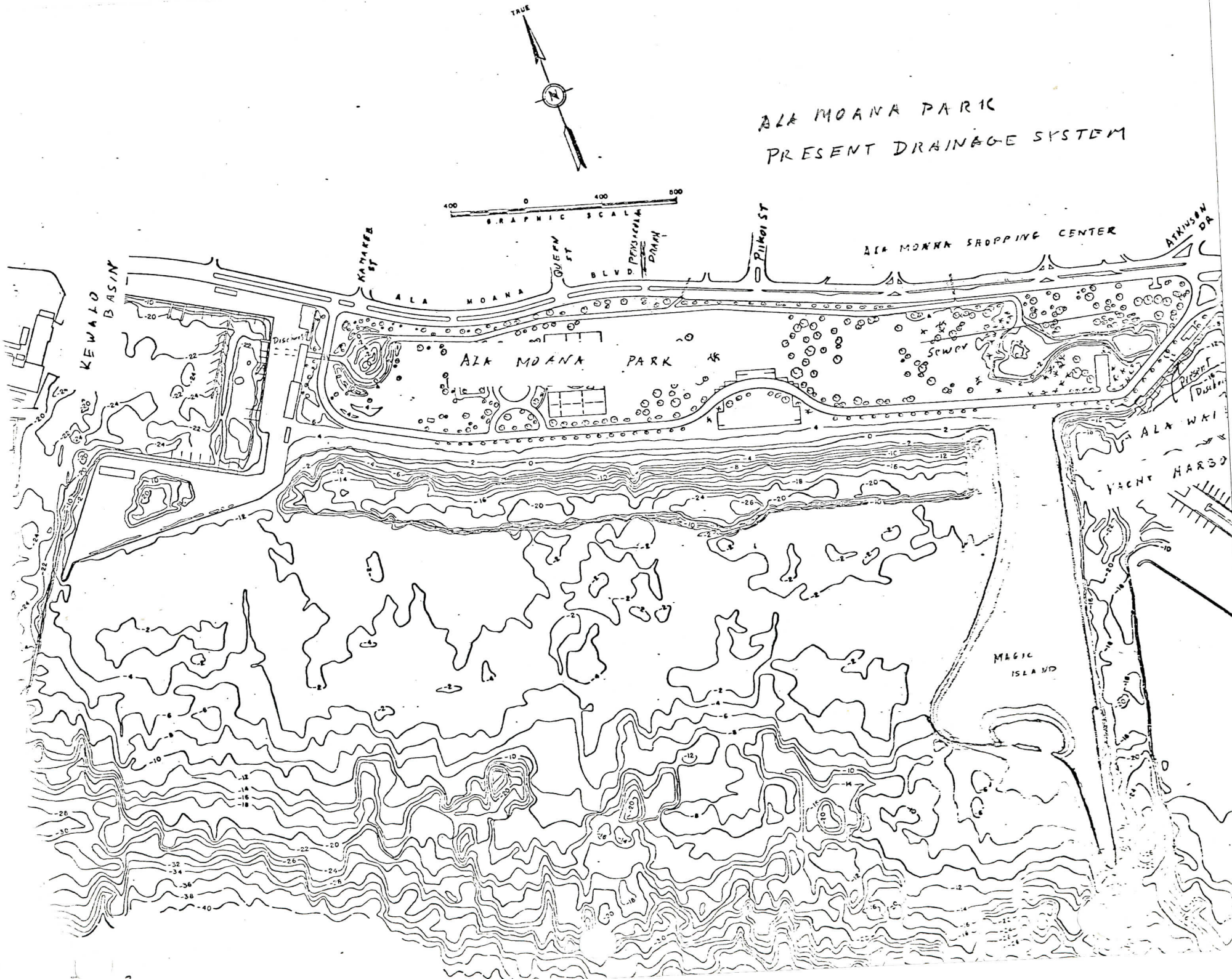
City Dept. Public Works
City Dept. Parks and Recreation


Punchbowl
Makiki Heights
Round Top
Rocky Hill
Moiliili
HONOLULU
Waikiki
Keiwalo Basin
ALA MOANA PARK
McKinley High Sch
Punahou Sch
Lincoln Sch
Roosevelt High Sch
Kaimuki High Sch
Washington Sch
University High Sch
Lunalilo Sch
Waikiki Sch
Thomas Jefferson Sch
Fort De Russy Military Res
Ala Wai Canal
Manoa-Palolo Drainage Canal
Ala Wai Yacht Harbor
Wreckwater
Markers
Pile
Wreck
Coral
Hospital
Water
Quarry
Stream
Pauoa
Kanaha
Konahuanui
Puu Kakea
Waiolei
Manoa Heights
Tantalus
Auwaiolimu
Nuuanu
Pauoa
Booth
Judd
Beretania
King
Young
Kapiolani
Kalakaua
Ala Moana
Ala Wai
Kamakee
Piikoi
Pensacola
Date
Isenberg
Dole
Lime
Round Top
Forest
Golf Course
Beach
Kapiolani
Fig. 1
AREAS DRAINED TO
ALA MOANA PARK
W. of Pensacola Drain ?
Pensacola Drain 165 acres
Piikoi Drain 115 acres
E. of Piikoi Drain 55 acres
N
SCALE 1:24 000
1 MILE
7000 FEET


ALA MOANA PARK
PRESENT DRAINAGE SYSTEM
TRUE
N
400 0 400 800
GRAPHIC SCALE
KEWALO BASIN
KAMAKEE ST
ALA MOANA BLVD
QUEEN ST
PENSACOLA DRAIN
PIIKOI ST
ALA MOANA SHOPPING CENTER
ATKINSON DR
ALA MOANA PARK
SEWER
ALA WAI
YACHT HARBOR
MAGIC ISLAND

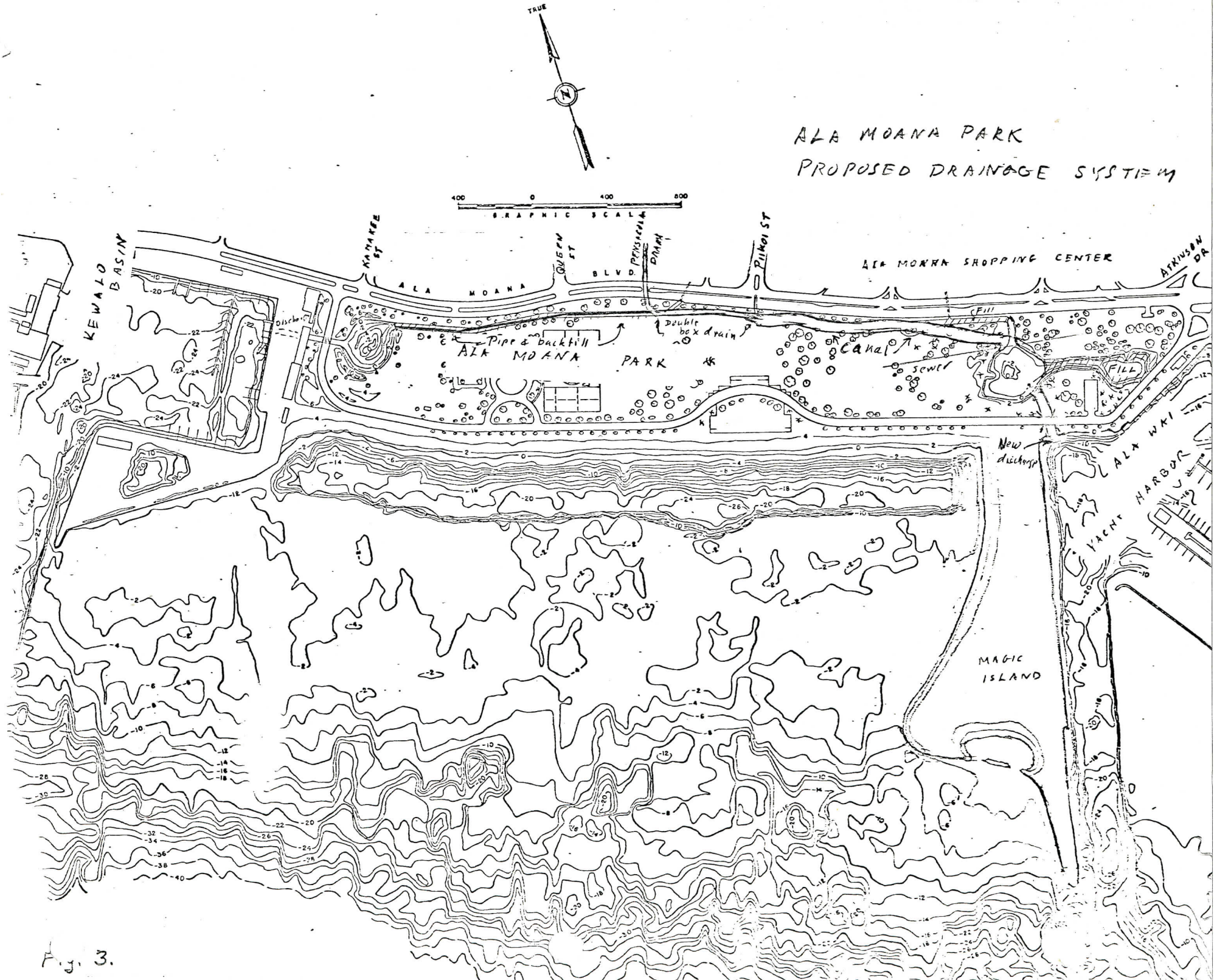

ALA MOANA PARK
PROPOSED DRAINAGE SYSTEM
TRUE
N
400 0 400 800
GRAPHIC SCALE
KEWALO BASIN
KAHAKEA ST
ALA MOANA BLVD.
QUEEN ST
PENSACOLA DRAIN
PIIKOI ST
ALA MOANA SHOPPING CENTER
ATKINSON DR
Discharge
Pipe & backfill
double box drain
ALA MOANA PARK
Canal
sewer
Fill
FILL
New discharge
ALA WAI
YACHT HARBOR
MAGIC ISLAND

Fig. 3.

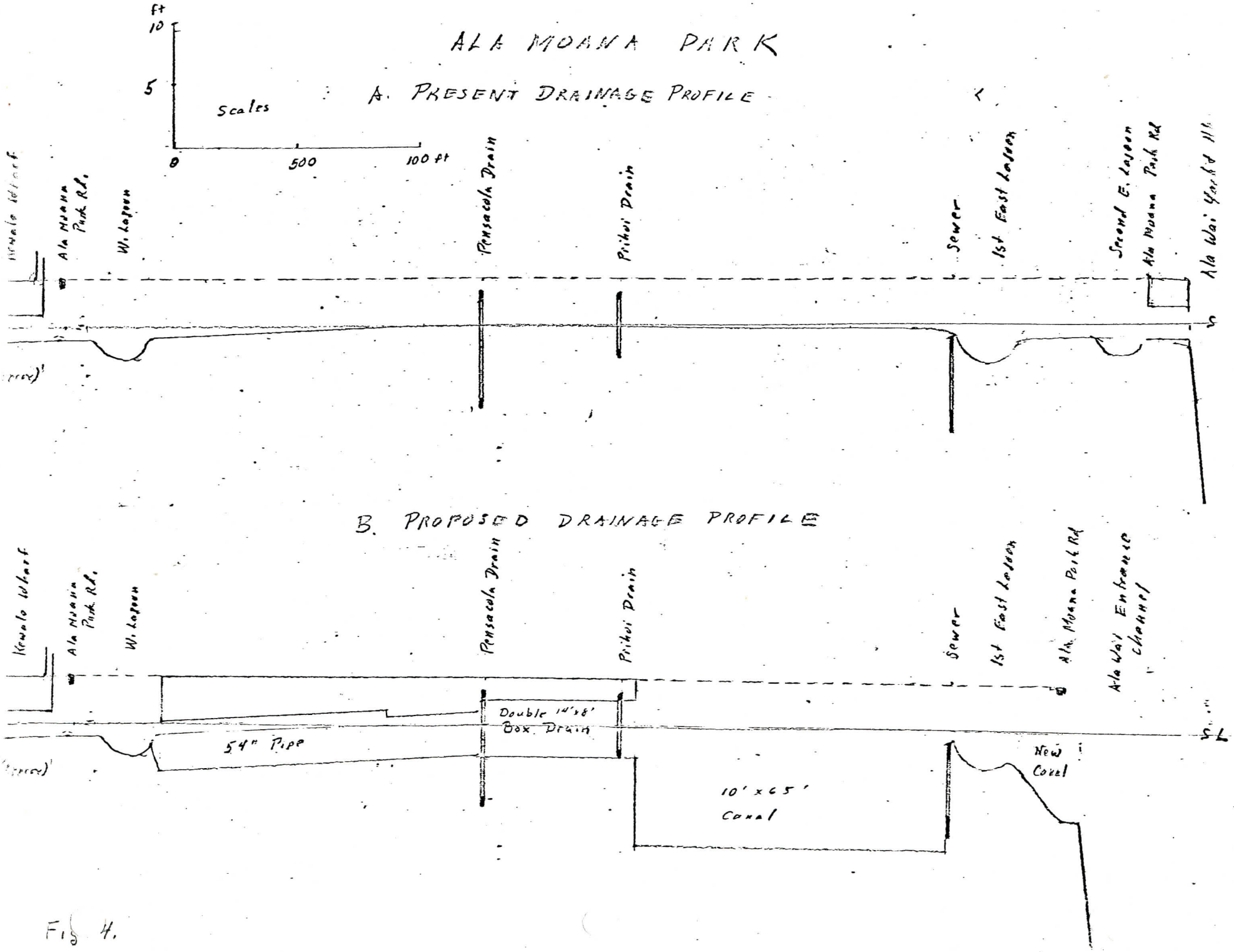
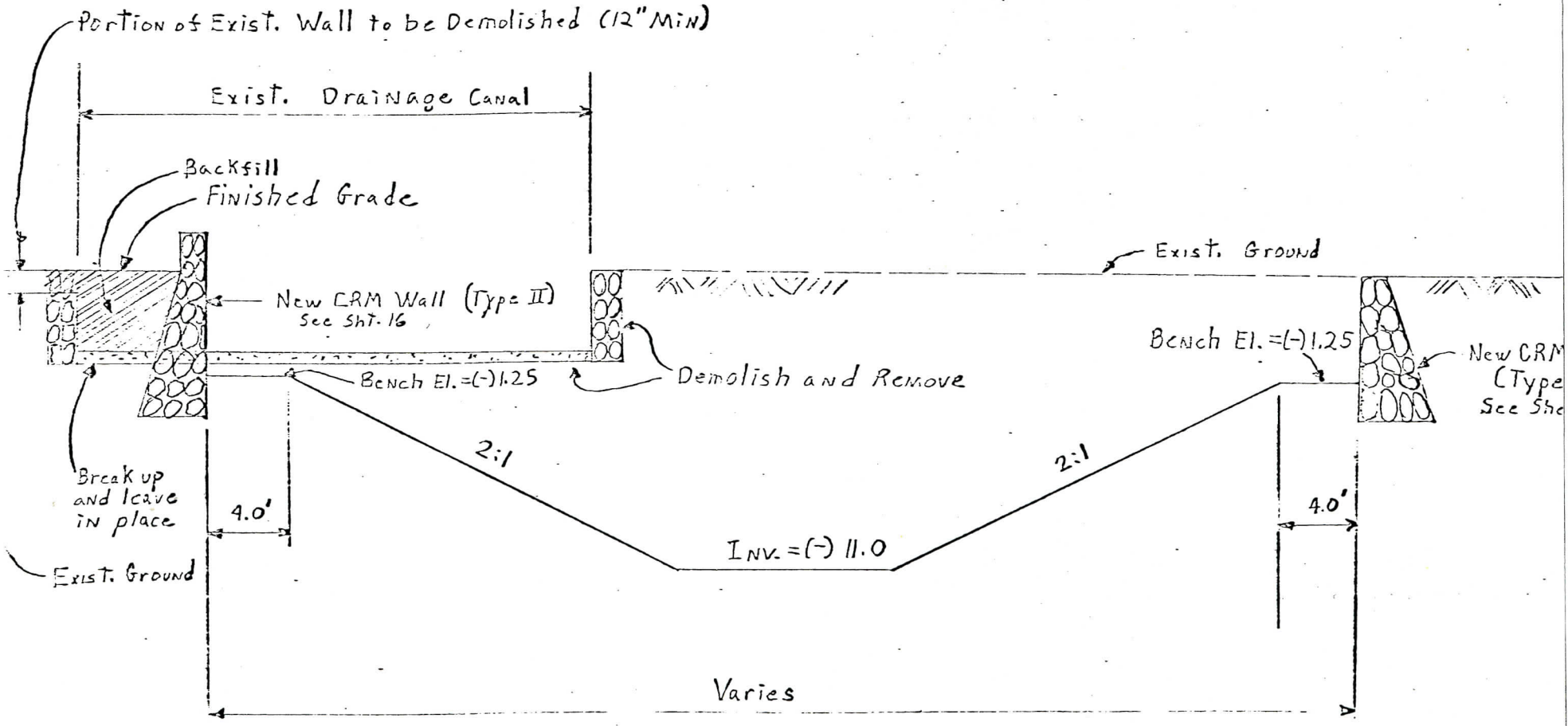

ALA MOANA PARK
A. PRESENT DRAINAGE PROFILE
ft
10
5
Scales
0
500
100 ft
Kewalo Wharf
Ala Moana Park Rd.
W. Lagoon
Pensacola Drain
Piikoi Drain
Sewer
1st East Lagoon
Second E. Lagoon
Ala Moana Park Rd
Ala Wai Yacht H
B. PROPOSED DRAINAGE PROFILE
Kewalo Wharf
Ala Moana Park Rd.
W. Lagoon
Pensacola Drain
Piikoi Drain
Sewer
1st East Lagoon
Ala Moana Park Rd
Ala Wai Entrance Channel
Double 14'x8' Box Drain
54" Pipe
10' x 6.5' Canal
New Canal

Fig 4.



Scale 1/8" = 1'-0"

Figure 5 TYPICAL DRAINAGE CANAL SECTION

Appendix A

(To be made one and eight copies)
SIXTH LEGISLATURE, 1972
STATE OF HAWAII

S.C.R. NO. 32

SENATE CONCURRENT RESOLUTION

REQUESTING THAT CAREFUL CONSIDERATION BE GIVEN TO ALA MOANA PARK IN THE ALA MOANA DRAINAGE CANAL WIDENING PROJECT.

WHEREAS, Hawaii's concern for its resources and for the provision of healthy and productive use of leisure time is evidenced in the provisions for outdoor recreation opportunities for its citizens and visitors; and

WHEREAS, Hawaii's leaders had the foresight to create Ala Moana Park many years ago, and in doing so, have met the challenge of providing high density recreation for today's burgeoning population; and

WHEREAS, as the only major park in the city of Honolulu, Ala Moana Park is constantly in use; and

WHEREAS, it provides wonderful picnic facilities, tennis courts, ball playing areas, beautiful swimming areas, and beach facilities, thus serving the recreational needs of a wide segment of the community; and

WHEREAS, our heritage of beautiful waters and natural beauty are gloriously manifest in Ala Moana Park, thus providing a restful hideaway, close to the central city area, from the bustling, urbanized work-a-day world of the common citizen; and

WHEREAS, this restful enticement is evidenced by the great numbers of people that are drawn to the park during week days and evening hours, as well as weekends; and

WHEREAS, the people of Hawaii cannot be accused of mere chauvinism for pride in their natural heritage, for the beauty and wonders of the State, including those at Ala Moana Park, constitute a diversified wealth of resources that awes the imagination; and

WHEREAS, because Hawaii is blessed with a tropical climate, the community can make use of the park facilities throughout the year; and

S.C.R. NO. 32

WHEREAS, the planned Ala Moana Drainage Canal Widening Project threatens to infringe upon Ala Moana Park, including the destruction of 365 rare historical and unusual trees; and

WHEREAS, at least eighty per cent of the trees at Ala Moana Park were planted in honor of local citizens and visiting dignitaries with the tree planting ceremony including the burial of a bottle in which the names of the participating citizens as well as a sum of money was enclosed; and

WHEREAS, Resolution No. 406, adopted on August 5, 1930, stated a policy for the City and County of Honolulu which was to "morally binding on succeeding Boards of Supervisors, to supply the labor for planting said trees..." and "to supply, and put in place, a suitable metal nameplate on each group of trees, marking it with the names of the donors and the schools the donors represent; said markers to be placed when the trees attain sufficient size to permit their marking as a permanent record of the interest shown by Hawaii's youth of today in the beautification of the Hawaii of the future"; and

WHEREAS, in recognition of this historically significant Resolution, it is imperative that appropriate actions now be taken to save these trees; and

WHEREAS, some of our heritage has already been squandered, with many of our waterways being polluted and much of our landscape being defaced, and in order to avoid further destruction and irretrievable loss, leaders with wisdom and foresight must recognize the need to preserve this natural wealth; now, therefore,

BE IT RESOLVED by the Senate of the Sixth Legislature of the State of Hawaii, Regular Session of 1972, the House of Representatives concurring, that the Mayor of the City and County of Honolulu, the Director of Public Works, and the Director of Parks and Recreation be requested to use utmost care in the design of the Ala Moana Drainage Canal Widening Project so as to assure minimal infringement on Ala Moana Park; and

BE IT FURTHER RESOLVED that certified copies of this Concurrent Resolution be transmitted to the Mayor of the City and County of Honolulu, and its Director of Public Works and Director of Parks and Recreation.

OFFERED BY: Kenneth T. Brown

Appendix B.

March 13, 1972

Dear Mayor Fasi:

This is in regard to the City's proposed plan to relocate the existing drainage canal and lagoon and make other improvements at Ala Moana Park.

As you may know, title to the park was conveyed from the Territory to the City by a Proclamation dated January 16, 1928, and signed by then Governor Farrington. The land was conveyed, however, subject to the condition that it be used solely as a public park or for other purposes of like nature. Hence it would appear that, absent the concurrence of the State, the use of lands at Ala Moana Park for the widening of the drainage canal would violate the terms of the Proclamation.

The State's review of the proposed project reveals that, although it may offer some advantages to the development of the mauka areas, it involves obvious disadvantages to those who use the park. Consequently, the State is unable to concur with the proposed project at this time.

I have requested the Chairman of the Board of Land and Natural Resources, the Honorable Sunao Kido, to advise the City as to what further information will be required in order for the State to finalize its position in this regard.

With warm personal regards. May the Almighty be with you and yours always.

Sincerely,

Honorable Frank F. Fasi
Mayor, City and County of Honolulu
Office of the Mayor
Honolulu, Hawaii

bcc: Honorable Sunao Kido (for follow-up)
Honorable George Pai

M.d. Burov
P.O. Box 239
Wahiawa, Oahu, Hawaii 96786
May 10th, 1972.

Dr. Doak Cox
Director
Environmental Center
University of Hawaii

Appendix C.

Value of Trees

Ala Moana Park Drainage Canal

Dear Dr. Cox,

This acknowledges your recent request for a memorandum on the value of the trees in the proposed Ala Moana Park Drainage Canal.

Number of Trees

There is some confusion over the number of trees that will be affected by the proposed canal.

The Sept. 1, 1971 Advance Print of Ala Moana Canal showed that the project would affect 31 species of 300 trees. Of these, 57 trees were to be destroyed, 17 trees were to be destroyed if necessary, 142 trees were to be removed and relocated and 84 trees were to be pruned. However, a more recent study by 25 "tree expert" members of the Hawaiian Botanical Society showed 84 location and identification errors in the Sept. 1, 1971 Advance Print maps - 44 trees were wrongly identified, 8 trees no longer existed and 32 trees were not on the original maps. The final tally showed a total of not 31, but 62 species of 364 trees - of which 85 trees were within the canal and 279 trees were outside the canal, but within the construction zone (Plan A) (Table 1). The new Dept. of Public Works Plan F reduces the number of trees within the canal by only 14 - to 71. The number of affected trees outside the canal is unknown - but could be greater than the original plan; because of the winding nature of the new plan. Therefore it is still possible that construction could affect between 350 to 400 trees. This of course does not include additional trees surrounding the lagoon, on the Waikiki side of the Park, which may be filled.

Uniqueness and Importance of Ala Moana Park Trees

1) Botanical Gardens: The trees in Ala Moana Park represent one of the finest collections of tropical seashore trees found anywhere in the United States. Because of this uniqueness the Hawaiian Botanical Society passed a resolution on March 6, 1972 recognizing Ala Moana Park as a major State Botanical Resource and Treasure and opposing any destruction of this resource. Ala Moana Park also contains one of the outstanding world collections of Ficus or Banyan trees (Condit, Ficus: The Exotic Species page 42). Some of these Banyans are so rare that they are still unidentified!

2) Memorial Park

About 80 to 90 per cent of the trees in Ala Moana Park were planted by or for local citizens and visiting dignitaries. Many people and organizations were involved. In some cases names of citizens participating in the tree planting ceremonies were placed in a bottle (sometimes with money) and buried under dedicated trees. On August 5, 1930 The City Board of Supervisors passed resolution No. 406 in which Oahu school children were asked to sprout 4,000 coconuts for Ala Moana Park, and the Board placed the government of the City and Council of Honolulu on record as agreeing to marking each group of coconut trees with metal labels listing the donors, and the schools the donors represented. President F.D. Roosevelt formally dedicated the Eastern entrance to Ala Moana Park on July 27, 1934 - and at the time was reported to have planted several memorial trees. In mid 1933 Charles Morrell and Bernice Belser dedicated the

cont.

first of many trees which were to be planted by citizens commemorating their wedding dates. On Sept. 31, 1933 Ben and Gay Dillingham planted a tree to mark their wedding. Governor Lawrence Judd planted a tree in May 1932. Mr. Moncado of the Moncado Filipino Federation was one of the last to dedicate a tree (in the early 1950's). Many organizations, including the Shriners, Lions and Comebackers planted trees. It was not uncommon for 3 or 4 trees to be dedicated on a single day. Maps were kept of these plantings - but unfortunately these maps since have been misplaced. Mr. Tom Miyashiro former supervisor of the Wahiawa Botanic Gardens was in charge of the tree maps from 1934-36. He recently pointed out that the "sentimental value" of the Ala Moana Park trees is very important. He considers Ala Moana to be a Memorial Park and feels that destroying or removing the trees would be like desecrating a cemetary.

3) Germ Plasm for New Crops - A number of rare trees in Ala Moana Park represent the basis for future new crops in Hawaii. For example Mimusops elengi could be grown as a perfume crop. Ceratonia siliqua (carob) is another promising tree crop. In "Opportunities for Hawaiian Agriculture"(page 124) Carob ranked 6th in importance among potential new crops. The seed gum is used in food and industry. In addition the flesh residue is very high in sugar. An expert at the HSPA Experiment Station estimated that more sugar might be returned per acre from carob than from sugar cane.

4) Other Uses:

The trees along the proposed Ala Moana Park Drainage Canal also have the following important uses:

a) Aesthetic value in total park appearance, for traffic along Ala Moana Blvd. and for shoppers at Ala Moana Center.
b) Educational value for all age groups.
c) Recreational value - shade, privacy for picnic areas and small recreational groups, jogging, walking, bird watching etc.
d) Buffer to traffic noise and pollution from Ala Moana Blvd.
e) Nesting area for birds.
f) Research value - reexamination of phenological rhythms in individuals studied 20 years ago.
g) Seed and flower source to lei and jewelry makers.

Value of Trees

1. The sentimental value of trees cannot be calculated. For example what is the value of a tree planted by President Roosevelt, Governor Judd or others?

2. The germ plasm value of a tree might be calculated if it proves to be the mother tree of a new variety or crop. For instance the original McIntosh apple and Hayden mango trees have been reported to be worth $200,000 and 50,000 each respectively. One tree could supply germ plasm for a crop which could employ thousands (e.g. carob). Its value then could be equated as a percentage of a person's salary. In selecting a tree for a new variety or crop often only one tree in 10,000 makes it. That one tree or more could be among the 62 species of trees along the proposed Ala Moana Park drainage canal.

3. Miscellaneous Value. The aesthetic, recreational, pollution control, educational, bird nesting and buffer values of trees also cannot be determined with any degree of concensus.

4. Michigan State Tree Value Schedule

The Michigan State Tree value formula is based on tree caliper. It has been used for 6 to 8 years and is one of the most commonly accepted methods of valuing shade trees (copy of the schedule is attached). Tree rarity is not considered. This formula was used by the Hawaiian Botanical Society to determine the non rarity value of 10 species of 44 dicot trees that were marked for destruction on the Sept. 1971 Ala Moana Advance Print. The total non rarity value of these trees came to $146,175 or $3322 per tree. Using this average, the value of the trees in Plans A, D and F can now be calculated using the following value assignments; based on rarity.

cont.

Tree Code			Estimated Rarity Value Per Tree
Red	- Retain at all cost	(x2)	$6,644
Orange	- Retain	(x1.5)	4,983
Blue	- Transplant with Extreme care	(x 1.0)	3,322
Green	- Transplant only if necessary	(x .75)	2,492
Brown	- Transplant or destroy	(x .5)	1,661

Tree Rarity Values - Within Canal Only (Trees in brackets)

Tree Code	Sept. 1971 Plan A	Covered Hawaiian Botanical Society Plan D	Public Works Plan F
Red	$ 86,372 (13)	$ 0 (0)	$ 13,932 (3)
Orange	149,490 (30)	9,966 (2)	179,388 (36)
Blue	106,304 (32)	3,322 (1)	15,610 (5)
Green	24,920 (10)	17,444 (7)	62,300 (25)
Brown	0 (0)	3,322 (2)	3,322 (2)
Totals	$367,086 (85)	$34,054 (12)	$274,552 (71)

The lowest within canal tree value of the above three plans was the covered canal with a tree value of $34,054. The Public Works Plan F and the original plan A are much more costly in terms of tree value i.e. $274,522 and $367,086 respectively.

In considering the trees outside the canal but within the construction area, and using an average rarity value of $4,022 / tree (average of all within canal values for Plans A, D and F) the total values for all trees affected in the three plans are as follows.

Rarity Tree Value (Trees in brackets)

	Original Plan A	Covered Plan D	Public Works Plan F
Within canal	$ 367,086 (85)	$ 34,054 (12)	$ 274,552 (71)
Outside canal	1,122,138 (279)	36,198 (9)	1,206,600 (300)
Total	$1,489,224 (364)	$ 70,252 (21)	$1,481,152 (371)

The cheapest plan in terms of tree value is the covered canal at $70,252; whereas the original Plan and Public Works Plan F are both about 20 x more costly at $1.5 million.

The above calculations have been verified by Dr. Don Watson of the UH Horticulture Dept. and assume that once a tree is removed from a given site that site becomes worthless in terms of tree value. If a young sapling is planted in its place then the sapling is only valued at its caliper thickness and might not reach the original rarity value of its predecessor for 30 or 40 years - if at all. If a tree is severely pruned or butchered then its ornamental and shade value would only be a proportion of the original value.

As a matter of interest the Sept. 1971 Canal plans called for the planting of only $4,730 worth of trees within Ala Moana Park as replacement for the trees that would be destroyed - when in actual fact the trees were worth up to $1.5 million.

H. R. Heuer

Chairman
Ala Moana Park Committee

TABLE 1 LIST OF SIXTY-TWO THREATENED TREE SPECIES IN THE CONSTRUCTION ZONE OF THE SEPT. 1, 1971 ALA MOANA PARK DRAINAGE CANAL ADVANCE PLAN

Albizzia lebbek
Andira inermis
Agathis australis
Adansonia digitata
Brassaia actinophylla
Brexia madagascariensis
Bucida buceras
Calophyllum inophyllum
Catalpa longissima
Ceratonia siliqua
Chrysalidocarpus lutescens
Clusia rosea
Cocos nucifera
Cocothrinax sp.
Conocarpus erectus
Copernicia cerifera
Crescentia cujete
Dolichandrone spathacea
Elaeodendron orientale
Enterolobiun cyclocarpum
Erythrina variegata var. orientalis
Ficus benjamina
Ficus benjamina var. comosa
Ficus benghalensis
Ficus elastica
Ficus glomerata
Ficus infectoria
Ficus macrophylla
Ficus microphylla
Ficus platypoda
Ficus retusa
Ficus rubiginosa
Guaiacum officinale
Guazuma ulmifolia
Heritiera littoralis
Kentia macarthuri
Kigelia pinnata
Lagunaria patersonii
Lantania loddogesii
Livistona chinensis
Melicocca bijuga
Messerschmidia argentea
Mimusops elengi
Noronhia emarginata
Olea europea
Pandanus odoratissimus
Peltophorum inerme
Piscidia piscipula
Platymiscium pinnatum
Pritchardia sp
Pterocarpus indicus
Ptychosperma elegens
Ptychosperma macarthurii
Roystonea regia
Sabal rexana
Samanea saman
Sapindus saponaria
Sterculia urens
Thespesia populnea
Thevetia peruviana
Veitchia sp.
Washingtonia filifera

Michigan State Tree Value Schedule

Contractor will be held to replace any trees damaged or destroyed by his operations during construction. Each tree on site will be given a replacement dollar value in conformance with the schedule listed below, and payments to the Contractor will be withheld as liquidated damages according to the following:

Schedule Showing Replacement Value of Specimen Trees

For trees 1" to 3" caliper diameter at rate of $100 per inch or $300 maximum.
For trees 3-1/2" to 6" caliper dia. at rate of $150 per inch or $900 maximum.
For trees 6-1/2" to 9" caliper dia. at rate of $200 per inch or $1,800 maximum.
For trees 9-1/2" to 12" caliper dia. at rate of $250 per inch or $3,000 maximum.
For trees 12-1/2" to 15" cal. dia. at rate of $350 per inch or $5,250 maximum.
For trees 15" or more cal. dia. at rate of $500 per inch $7,500 or more, dependent on size.

Where partial damage occurs, Owner may choose to make repairs and retain the specimen. The University Landscape Architect will evaluate such damage, and will set proportional amounts, up to 100% of the calculated replacement value regardless of the disposition of the particular specimen.

Note:
Above Figures were submitted to the UM Planning Dept. for inclusion in future contracts (For building construction) by the UM Committee on Campus Environment in the late 1970